Khulna University of Engineering & Technology
B. Sc. Engineering 2nd Year 1st Term Examination, 2018
Department of Biomedical Engineering

BME 2151
Numerical Methods and Statistics

Time: 3 hours **Full Marks: 210**

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.
iii) Chi-square (χ^2) distribution chart will be provided on request.

Section A

(Answer **ANY THREE** questions from this section in Script A)

1. a) What is numerical error? Find the roundoff error in storing the number 745.6835 using a four digit mantissa. (06)

b) What is error propagation? Draw a block diagram for evaluation of $x^2 + y^2 + z^2$. (06)

c) Find a root of the equation $x^2 + 5x - 12 = 0$ using bisection method (upto 5th iteration). (12)

d) Use the secant method to compute a root of the equation $4x^3 - 2x - 6 = 0$ with the initial estimates of $x_1 = 2$ and $x_2 = 3$. (11)

2. a) Fit a second order Newton's interpolating polynomial to estimate cos1.15 using the given data table. (11)

x	1.0	1.1	1.2
cosx	0.5403	0.4536	0.3624

b) Find the Lagrange interpolation polynomial to fit the following data. (14)

i	0	1	2	3
x_i	0	1	2	3
e^{x_i}	1	2.7183	7.3891	20.0855

c) Approximate the derivative of $f(x) = x^2 + 2x$ at $x = 4$ using the Forward, Backward and Central difference method with step size 1. (10)

3. a) Solve the system (12)

$$2x_1 + 4x_2 - 6x_3 = -8$$
$$x_1 + 3x_2 + x_3 = 10$$
$$2x_1 - 4x_2 - 2x_3 = -12$$

Using Gauss-Jordan method.

b) Evaluate the integral (08)

$$I = \int_a^b (x^3 + 1)dx$$

for the intervals (i) (1, 2) and (ii) (1, 1.5) using trapezoidal rule.

c) Compute Romberg estimate R_{22} for (15)

$$\int_1^2 \frac{1}{x} dx$$

4. a) Estimate $y(2)$ by Heun's method for the following equation using $y(1) = 2$ and $h = 0.5$. (10)

$$\frac{dy}{dx} = x^2 + y^2$$

b) Use the classical RK method to estimate $y(0.5)$ when $y'(x) = {}^{x}/_{y}$ with $y(0) = 1$ and $h = 0.25$. (14)

c) Solve the steady-state temperatures in a rectangular plate 9cm×12cm, if one 12cm side is held at 50°c, and the other 12cm side is held at 30°c and the other two sides are held at 10°c. Assume square grids of size 3cm×3cm. (11)

Section B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Define probability, sample space and mutually exclusive event. (06)

b) A laboratory blood test is 99% effective in detecting a certain disease when it is, in fact, present. However, the test also yields a 'false positive' result for 1% of the healthy persons tested. (That is, if a healthy person is tested, then, with probability 0.01, the test result will imply he or she has the disease.). If 0.5% of the population actually has the disease, what is the probability a person has the disease given that his test result is positive? (12)

c) Two six-sided (balanced) dice are thrown simultaneously. Find the probability of each of the following events: (10)

(i) a 5 and a 3 occur in any order
(ii) a 5 does not occur in either throw
(iii) one roll is a 4 given that the sum is 7.

d) X is uniformly distributed over 5 to 15, calculate the probability that (i) $X < 6$; (ii) $7 < X < 10$. (07)

5. a) Define random variable, independent event, pdf and cdf. (08)

b) A bag of cookies is under weight if it weighs less than 400 grams. The filling process dispenses cookies with weight that follows the normal distribution with mean 408 grams and standard deviation 4 grams. What is the probability that a randomly selected bag is under weight? (09)

c) Table 6(c) shows frequency distribution of the lifetime of 100 tube lights at a company. Determine the followings: (18)

(i) construct a relative frequency polygon
(ii) mean lifetime of the 100 tube lights using coding method
(iii) standard deviation of the 100 tube lights.

Table 6(c)

Lifetime (hours)	No. of tube lights
300-399	14
400-499	17
500-599	28
600-699	12
700-799	13
800-899	09
900-999	07
Total	100

7. a) State and prove Pearson linear correlation coefficient formula. (10)

b) Fit a least square parabola, having the form $Y = a_0 + a_1X + a_2X^2$ to the given data shown in table 7(b). (11)

Table 7(b)

X	2	3.1	4.4	6	8.5
Y	3.1	6	7.5	8	5

c) If $x = X - \bar{X}$ and $y = Y - \bar{Y}$, show that, standard error of estimate of Y on X, (07)

$$S_{Y,X} = \sqrt{\frac{\sum y^2 - a_1 \sum xy}{N}}$$

d) Define correlation in statistics. Discuss different methods of curve fitting. (07)

8. a) What is hypothesis testing? Define type I & II error, what is p-value and critical value? (10)

b) Last year's color distribution of sold car is given in table 8b(i). This year's observation in the color distribution of sold car is given in table 8b(ii). Do the data provide sufficient evidence to conclude that the color distribution of sold car differs from the last year? Use 5% and 1% level of significance. Use chi-square test. (12)

Table 8b(i)

Color	**Percentage**
Brown	30
Yellow	20
Red	20
Orange	10
Green	10
Blue	10

Table 8b(ii)

Color	**Observed frequency**
Brown	152
Yellow	114
Red	106
Orange	51
Green	43
Blue	43
Total	509

c) Table 8(c) shows Glucose level of male and female patients in a hospital. At 1% significance level, do the data provide sufficient evidence to conclude that, on average, male patients have higher glucose level than female patients? (13)

Table 8(c)

Glucose level (units)	
Male	Female
13, 22, 18, 09, 30, 11	20, 32, 12, 11, 08, 14

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd Year 1st Term Examination, 2018
Department of Biomedical Engineering

ECE 2115
(Digital Electronics and Logic Design)

Time: 3 hours **Full Marks: 210**

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION-A
(Answer **ANY THREE** questions from this section in Script A)

1. (a) Design a Binary to Gray code converters. Draw the logic circuit of the converter. What are the features of Gray code? (15)

(b) Find the minimal expression of the following functions using Karnaugh's Map: (10)

(i) $F(A,B,C,D) = \sum(0,2,3,5,6,7,8,9)$ (ii) $d(A,B,C,D) = \sum(10,11,12,13,14,15)$

(c) Describe De Morgan's theorem. Using this theorem, calculate the complement of function F, where $F = A'[(B+C)' + B'C']$. (10)

2. (a) Describe the necessity of using complements. Perform the subtraction using 2's complement and 9's complement respectively: (10)
(i) $(100)_2$ - $(110000)_2$ (ii) $(753)_{10}$ - $(864)_{10}$

(b) What is meant by self complementary code and weighted code? Justify the statement "Excess-3 code is self complementary code but not a weighted code". (09)

(c) Convert the following numbers from Gray to Binary: (06)
(i) 101011 (ii) 10110 (iii) 1001101

(d) Convert the following numbers from the given base to the bases indicated: (10)
(i) Hexadecimal $(2D7EF)_H$ to Decimal, Octal, and Binary
(ii) Decimal $(31.27)_{10}$ to Binary, Octal, and Hexadecimal.

3. (a) Design a full-adder circuit with two half-adders and one OR gate. Also, show that a full-adder circuit can be implemented with a decoder and two OR gates. (15)

(b) Implement the Boolean function with a multiplexer: (10)

$$F(A,B,C,D) = \sum(0,1,3,4,8,9,15)$$

(c) Write short note on Read Only Memory (ROM). Design a combinational logic circuit using a ROM that accepts a 3-bit number and generates an output binary number equal to the square of the input number. (10)

4. (a) Convert the following to the other canonical form: (08)

$$F(x,y,z) = \prod(0,3,6,7)$$

(b) A seven bit Hamming code with even parity is received as: (09)
(i) 1011001 (ii) 0010101 (iii) 1011011
Locate the error position if any and find the correct message.

(c) Express the following functions in a sum of Minterms and a product of Maxterms: (10)
(i) $F(A,B,C) = (A'+B)(B'+C)$ (ii) $F(x,y,z) = (xy+z)(y+xz)$

(d) What is meant by universal gate? Implement the following Boolean function using NAND gate: $F = A(BC'+D) + B'C$. (08)

SECTION-B

(Answer **ANY THREE** questions from this section in Script B)

5. (a) What is meant by sequential logic circuits? How it differs from combinational circuit? (06)

(b) Write down the differences between: (08)

(i) Synchronous and Asynchronous sequential circuit

(ii) Flip-flop and Latch

(c) Explain the timing problem in JK or T flip-flop with flip-flop operation. Also describe how edge-triggering or pulse transition eliminates this time problem. (12)

(d) How it is possible to switch the output of a flip-flop and its input with the same clock pulse in a master-slave flip-flop? (09)

6. (a) Design a clocked sequential circuit from the state diagram given in Fig. 6(a) using RS flip-flop. (12)

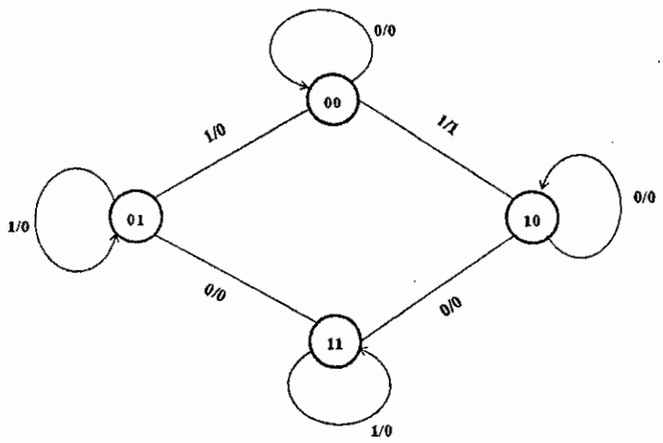

Fig. 6(a)

(b) What is the difference between serial and parallel loading? Draw the logic diagram and explain the operation of a universal shift register. (13)

(c) Design a synchronous counter that will count 15 - 10 - 9 - 8 - 7 - 6 and repeat by using JK flip-flops. (10)

7. (a) What is serial addition? Explain the serial adder sequential circuit using JK flip-flop. (10)

(b) Construct a Johnson counter with ten timing signals. (10)

(c) What is Moore's law? What are the general characteristics of basic logic gates. (07)

(d) Design CMOS digital circuits that realizes the following Boolean functions: (08)

(i) $y = abc + d'$ (ii) $y = ab' + c'(a + b)$

8. (a) Write short notes on: (05)

(i) Fan-in

(ii) Fan-out

(b) Describe the operation of RTL, DTL and ECL NOR gate. (15)

(c) What are the types of TTL logic family? Explain each type with proper logic diagram. (10)

(d) What is PLD? How many types of PLD in digital electronics? (05)

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Math 2115
Transforms Analysis

Time: 3 hours **Full Marks: 210**

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

Section A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Define causal and non-causal signals. Check whether the following signal are causal or not: (13)

(i) $y(t) = x(t^2)$, (ii) $y(t) = x^2(t)$, (iii) $y(n) = x(n) - x(n-1)$

b) Determine the z-transform including the region of convergence of (10)

$$x(n) = \begin{cases} a^n, & n \geq 0 \\ 0, & n < 0 \end{cases}$$

c) Find the signal $x(n)$ by using convolution for (12)

$$X(z) = \frac{1}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 + \frac{1}{4}z^{-1}\right)}$$

2. a) By applying the time shifting property, determine the signal (09)

$$X(z) = \frac{z^{-1}}{1 - 3z^{-1}}$$

b) Determine the convolution of the two sequences $x(n) = \{2, 1, 0, 0.5\}$ and $h(n) = \{2, 2, 1, 1\}$. (10)

c) Find the inverse z-transform of (16)

$$X(z) = \frac{2 + 3z^{-1}}{(1 + z^{-1})\left(1 + \frac{1}{2}z^{-1}\right)\left(1 - \frac{1}{4}z^{-1}\right)}, |z| > \frac{1}{2}$$

using partial fraction method.

3. a) Define integral transform, find the kernel of the transform. Hence find the kernel of Fourier cosine transform. (08)

b) Define Discrete Fourier Transform (DFT). Determine the 4-point DFT of the data sequence $x(n) = cos\frac{n\pi}{4}$ and compute the corresponding amplitude and phase spectrum. (15)

c) Find the IDFT of $X(k) = \{1, 2, 3, 4\}$. (12)

4. a) Given $x(n) = 2^n$ and $N = 8$. Find $X(k)$ using DITFFT algorithm. (17)

b) For $X(k) = \{20, -5.828 - j2.414,\ 0, -0.172 - j0.414, 0, -0.172 + j0.414, 0, -5.828 + j2.414\ \}$, find $x(n)$ using IDFT algorithm. (18)

Section B

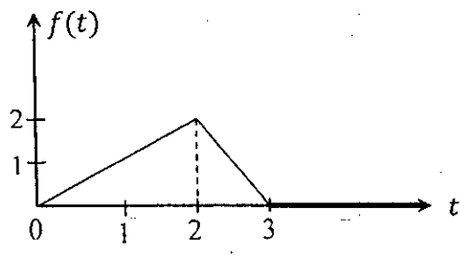
(Answer **ANY THREE** questions from this section in Script B)

5. a) What are the sufficient conditions to have its Laplace transforms of a function? (10)

Check whether the following functions satisfy those conditions:

(i) $sin(e^{t^2})$ (ii) e^{t^2}

b) Find the Laplace transforms of the function $f(t)$ whose graph is given below: (11)



Hints: use unit step function

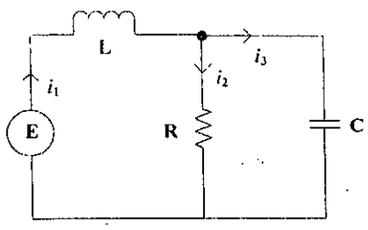
c) Use the convolution theorem to find (14)

$$\mathcal{L}^{-1}\left\{\frac{1}{(s+2)^2(s-2)}\right\}$$

6. a) Write down the dirichlets condition for Fourier series. Obtain the Fourier series expansion of $f(x) = x \sin x$ in the interval $-\pi < x < \pi$, and deduce that, (20)

$$\frac{\pi}{4} = \frac{1}{2} + \frac{1}{1.3} - \frac{1}{3.5} + \frac{1}{5.7} - \ldots\ldots\ldots\ldots$$

b) Solve the circuit using Laplace transform (15)



to find the current i_1, i_2, i_3 under the conditions $E(t) = 60V, L = 1h, R = 50\Omega$ and $c = 10^{-4}f$, and the i_1 and i_2 are initially zero.

7. a) Write parseval's identity corresponding the Fourier series of the function (19)

$$f(x) = \begin{cases} x, & 0 < x < 2 \\ -x, & -2 < x < 0 \end{cases}$$

b) Find the Fourier transform of (16)

$$f(x) = \begin{cases} 1 - x^2, & |x| \le 1 \\ 0 \quad , & |x| > 1 \end{cases}$$

8. a) Find the Fourier series representation of (10)

$$f(t) = \begin{cases} -k\ ; & -\pi \le t < 0 \\ k\ ; & 0 \le t \le \pi \end{cases}$$

defined over a single period.

b) Expand $h(x) = sinx,\ 0 < x < \pi$, in a Fourier cosine series. (10)

c) Find the finite Fourier cosine transform of $f(x)$ where, (15)

$$f(x) = \begin{cases} 1 & for \quad 0 \le x \le \frac{\pi}{2} \\ -1 & for \quad -\frac{\pi}{2} < x < 0 \end{cases}$$

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd Year 1st Term Examination, 2018
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ME 2115

(Basic Mechanics and Thermodynamics)

Time: 3 hours **Full Marks: 210**

N.B.i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION-A

(Answer **ANY THREE** questions from this section in Script A)

1. (a) Two cables tied together at C are loaded as shown in Fig. 1(a). Knowing that the maximum allowable tension in each cable is 800 N, determine (i) the magnitude of the largest force P that can be applied at C, (ii) the corresponding value of α. (17)

   (b) Three cables are connected at A, where the force P and Q are applied as shown in Fig. 1(b). Knowing that P = 1200 N, determine the values of Q for which cable AD is taut. (18)

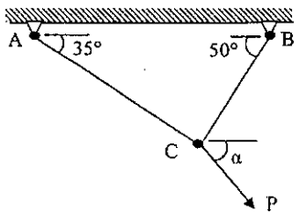

Fig. 1(a)

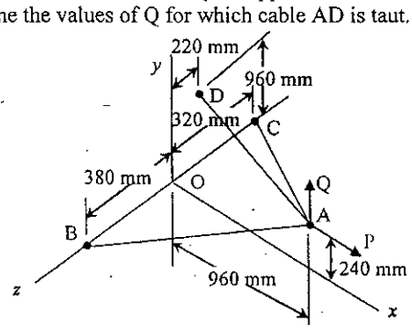

Fig. 1(b)

2. (a) A lever AB is hinged at C and attached to a control cable at A shown in Fig. 2(a). If the lever is subjected to a 500 N horizontal force at B, determine (i) the tension in the cable, (ii) the reaction at C. (15)

   (b) A 10 ft boom is acted upon by the 840 lb force as shwon in Fig. 2(b). Determine the tension in each cable and the reaction at the ball and socket-joint A. (20)

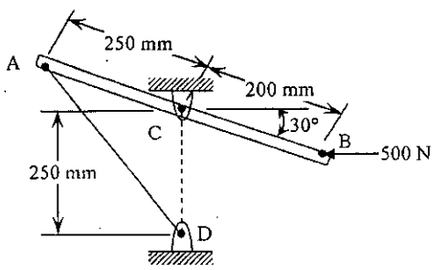

Fig. 2(a)

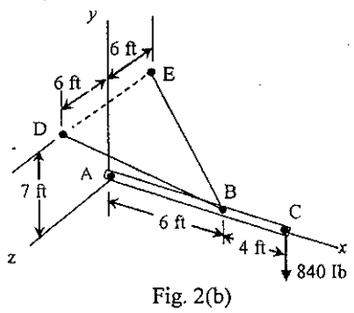

Fig. 2(b)

3. (a) A cube of side a is acted upon by a force P as shown in Fig. 3(a). Determine the moment of P about the diagonal AG of the cube. (10)

   (b) A 160 N force P is applied at point A of a structural member shown in Fig. 3(b). Replace P with an equivalent system consisting of a vertical force at B and a second force at D. (12)

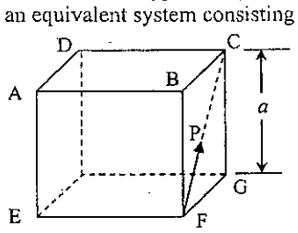

Fig. 3(a)

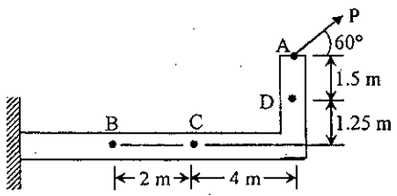

Fig. 3(b)

(c) Determine centroid of the following area: (13)

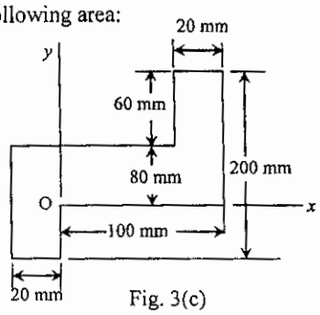

Fig. 3(c)

4. (a) What is metabolism and basal metabolic rate? Explain how the biological system of human body can be compared with thermodynamic heat engine? (12)

(b) How thermodynamics and heat transfer are related? Explain the modes of heat transfer. (12)

(c) Explain the zeroth law of thermodynamics. Why this law is called the basis of temperature measurement? (11)

SECTION-B

(Answer **ANY THREE** questions from this section in Script B)

5. (a) What are the limitations of 1st law of thermodynamics? Write down the two statements of 2nd law and show that the laws are equivalent. Explain how the two laws of 2nd law are related with the thermodynamic heat engine and refrigerator? (22)

(b) 6.5 kg of a gas expands within a flexible container so that the pressure-volume relation is of the form $PV^{1.35}$ = constant. The initial pressure is 1.0 mPa and the final pressure is 5 kPa. The initial volume is 1.25 m^3. The specific internal energy of the gas decreases by 42.5 kJ. Find the heat transfer in magnitude and direction. (13)

6. (a) What is perpetual motion machine? Explain why a steam power plant without a condenser is a perpetual motion machine of second kind? Why this plant will not work? (13)

(b) What is absolute pressure and gage pressure? With appropriate sketch explain the relationship between absolute pressure, gage pressure and atmospheric pressure. (10)

(c) How the hydrostatic force on curved submerge surface can be determined? Why it is not possible to obtain a general formula for curved surface? Explain. (12)

7. (a) What is fluid? Mention the main properties of fluid that separates it from solid. Explain why a liquid droplet attain minimum possible surface area? Deduce the pressure jump across the surface of a liquid droplet. (13)

(b) What is meant by stability of floating body? Explain with appropriate sketch the stability criteria of floating body. (10)

(c) The gate in Fig. 7(c) is 1.5 m wide is hinged at point B, and rests against a smooth wall at point A. Compute the force on the gate due to seawater pressure. (12)

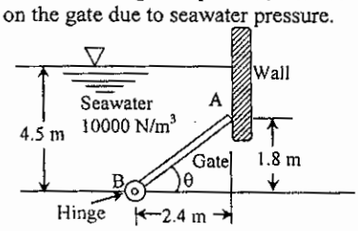

Fig. 7(c)

8. (a) Explain the following types of flow: (10)
(i) Steady flow (ii) Uniform flow (iii) One, two, and three dimensional flow

(b) Based on mass conservation equation, prove that the rate of increase of mass in a control volume must be equal to the net inflow of mass through the control surface for steady flow. (10)

(c) Gasoline at 20°c (ρ = 680 kg/m^3) is pumped through a smooth 12 cm diameter pipe 10 km long, at a flow rate of 75 m^3/h. The inlet is fed by a pump at an absolute pressure of 24 atm. The exit is at standard atmospheric pressure and is 150 m higher. Estimate the frictional head loss. (15)

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BME 2101
Human Anatomy

Time: 3 hours **Full Marks: 210**

N.B.i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION-A

(Answer **ANY THREE** questions from this section in Script A)

1.	(a)	What are the parts of stomach? Name the structures forming stomach bed with diagram.	(10)
	(b)	Give the posterior relation of right kidney. Write down the mode of blood supply of kidney.	(10)
	(c)	Write down the difference between large and small intestine.	(10)
	(d)	Write a short note on Histological structure of liver.	(05)
2.	(a)	Describe the structure of larynx. Give the nerve supply and blood supply of larynx.	(12)
	(b)	What are the muscles of the tongue. Write down the nerve supply of tongue.	(12)
	(c)	Enumerate the terminal branches of the facial nerve.	(06)
	(d)	Write a short note on pharynx.	(05)
3.	(a)	List the name of 12 cranial nerves. Mention their types and function.	(12)
	(b)	Describe the importance of hypothalamus.	(08)
	(c)	Write down the functional and phylogenetic subdivision of cerebellum and enumerate their functions in details.	(10)
	(d)	Write a short note on Spinal cord.	(05)
4.	(a)	Enumerate different lobes of the brain with their functions.	(10)
	(b)	Draw and label the important nuclei of thalamus. Write down the functions of thalamus.	(12)
	(c)	Mention the major organ systems of the body and enumerate their functions.	(08)
	(d)	Write a short note on Basal ganglia.	(05)

SECTION-B

(Answer **ANY THREE** questions from this section in Script B)

5. (a) What are the layers of Thoracic wall? Write down the name of the muscles and function of thoracic wall. (07)

   (b) What is mediastinum? How the mediastinum is divided into two parts? List the contents of the Superior mediastinum. (08)

   (c) Draw and label the Diaphragm with the opening and structure passing through it. (10)

   (d) Write short notes on: (10)
   - i) Ascending aorta
   - ii) Superior venacava

6. (a) Draw and label the bronchopulmonary segment of both lungs. (10)

   (b) Enumerate the difference of Right and left lung. Write down the lobes and fissure of right lung. (05)

   (c) What is pleura? Write down the parts and nerve supply of the pleura. (05)

   (d) Illustrate the fetal circulation with schematic diagram. (15)

7. (a) Enumerate the name of the bones and joints of the upper limb. Write down the line of force transmission in the upper limb. (10)

   (b) Give the origin, insertion and nerve supply of the following muscles; (10)
   - i) Triceps
   - ii) Pectoralis major.

   (c) Draw and label the brachial plexus and briefly discuss its root, trunk, cord and branches. (10)

   (d) Illustrate the boundary and contents of the Axilla. (05)

8. (a) How the pelvic inlet is form? List the different types of pelvis. (05)

   (b) Write down the boundary and contents of Femoral triangle and Adductor canal. (10)

   (c) What are the bones of the foot? Briefly discuss the arch of the foot. (10)

   (d) Write short notes on: (10)
   - (i) Calf muscle
   - (ii) Quadriceps muscle.